

General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

BTS07-84-08/7b
1049

February 1984

**A COMPILATION OF MINERAL OCCURRENCES
AND THE RELATIONSHIP OF OCCURRENCES
TO STRUCTURAL ELEMENTS OF THE
KENTUCKY AND TENNESSEE REGION**

by

M. A. Mayhew*

D. M. Myers

Contract NAS 5-27597



Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Goddard Space Flight Center
Greenbelt, Maryland 20771

Prepared by

BUSINESS AND TECHNOLOGICAL SYSTEMS, INC.
Aerospace Building, Suite 440
10210 Greenbelt Road
Seabrook, Maryland 20706

*Currently with the National Science Foundation, Washington, DC

(NASA-CR-175240) A COMPILATION OF MINERAL
OCCURRENCES AND THE RELATIONSHIP OF
OCCURRENCES TO STRUCTURAL ELEMENTS OF THE
KENTUCKY AND TENNESSEE REGION (Business and
Technological Systems, Inc.) 12 p

N84-28275

Unclas
G3/46 13946

1.0 INTRODUCTION

A very prominent magnetic anomaly measured by Magsat over the eastern mid-continent of the United States was inferred to have a source region beneath Kentucky and Tennessee (Mayhew and Galliher, 1982). Mayhew et al (1982) noted that prominent aeromagnetic and gravity anomalies are associated with the inferred source region. They constructed a crustal model to fit these anomalies, and interpreted the complex as a large mafic plutonic intrusion of Precambrian age. The complex was named the "Kentucky body". It was noticed that the Jessamine Dome, which is a locus of intense faulting and mineralization, occurs near the northern end of the Kentucky body, and that more generally there seemed to be a spatial relationship between mineral occurrence and the body. This study involved obtaining source material from the U.S. Geological Survey and elsewhere on mineral occurrence in Kentucky and Tennessee, and investigating further whether the distribution of deposits is related in some way to the Kentucky body. A compilation of mineral occurrences in the region, classified according to type and age, is presented in the figures of the report.

1.1 Mineral Deposits

Material in this section is synthesized principally from Lawrence (1968), Jolly and Heyl (1964), Kyle (1976), McKnight et al (1962a,b), Worl et al (1974), Brobst and Hobbs (1968), Wedow et al (1968), and Van Alstine and Sweeney (1968). Four mineral commodities are of interest to this study; they are barite, fluorite, lead, and zinc. These occur together in various proportions over a wide geographic area, and are genetically related. They occupy two principal stratigraphic positions in the lower Paleozoic carbonate sequence, mainly in the upper part of the Knox Group of early Ordovician age, and secondarily in the early Cambrian Shady Dolomite, although in places the deposits have also been found in higher stratigraphic levels. The principal (Ordovician) deposits probably formed in a karst terrain developed on the

post-early Ordovician unconformity (Lawrence, 1968). Thus they are found concentrated as vein and cavity fillings and residual deposits derived from these, and in breccia zones resulting from collapse related to carbonate solution. Where faults and fracture zones are present, notably in the Jessamine (or Lexington) dome, these commonly have formed pathways for mineralizing solutions.

The mineral distributions and types are summarized in tabular form in Table 1 and in the map of Figure 1. The small dots in Figure 1 indicate the distribution of significant fluorite deposits which include important concentrations of lead, zinc, and barite. Areas a and b enclosed by dashed lines contain many small deposits of lead-zinc-barite-fluorite, and are associated with the Jessamine and Nashville domes, respectively. Locations 1 and 2 represent other significant deposits. Deposits indicated by location 3 are associated with the Elliott County kimberlite (which occurs within the Rome Trough), and are genetically unrelated to the others.

The carbonate-hosted deposits are considered to be of "Mississippi Valley" type, much like those further to the west, and thus the site of deposition may be far from the original, presumably magmatic, source. On the other hand, Jolly and Heyl (1964) presented arguments for a local, deep-seated magmatic body beneath the Jessamine Dome as both the source of the mineralizing fluids and the cause of the intense fracturing. In any case, the age of the mineralization is much less than (perhaps one third) that of the plutonic complex making up the Kentucky body.

1.2 Relation to Large-Scale Structures

The lead-zinc-barite-fluorite mineralization in Kentucky and Tennessee is clearly related to the Cincinnati Arch (Figures 1 and 3), a broad linear domal feature which experienced recurrent vertical movement throughout the Paleozoic. The up-arching of the mineralized stratigraphic levels over the Arch and exposure by erosion explains the association. A sag in the structure occurs where the eastern extension of the Rough Creek Graben

(Soderberg and Keller, 1981) continues into the Rome Trough (Ammerman and Keller, 1979) and crosses the Arch, separating it along its length into the Jessamine and Nashville domes. This explains the association of zones a and b of Figure 1 with the two domes.

Although a direct genetic relationship between the mineral deposits and the Kentucky body seems unlikely because of the great age difference, there does seem to be a close geographic relationship between the Kentucky body and the Cincinnati Arch. The most direct explanation for this is that there has been differential vertical movement between the two due to the anomalously large density of the Kentucky body.

Table 1

<u>Symbol</u>	<u>Location</u>	<u>Description</u>
• a 1	Central Kentucky District	Barite, fluorite, sphalerite, and galena in fissure veins in Ordovician limestones.
2	Cumberland River Area, Kentucky	Sphalerite, galena, barite, and calcite fissure veins similar to those of Central Kentucky and Central Tennessee districts.
b	Central Tennessee District	Barite, fluorite, sphalerite, galena and calcite fissure veins in Lower and Middle Ordovician limestones. Very large manto and breccia deposits of fluorite, barite, and sphalerite in Lower Ordovician dolomites extending up into Middle Ordovician limestones.
3	Elliott County kimberlites	Fluorite-bearing igneous breccia and tactite zones of Pennsylvanian or Permian age.

REFERENCES

- Ammerman, M. L. and G. R. Keller, Delineation of Rome Trough in eastern Kentucky by gravity and deep drilling data, Amer. Assoc. Petrol. Geologists Bull., 63, 341-353, 1979.
- Brobst, D. A., and R. G. Hobbs, Barite, in Mineral Resources of the Appalachian Region, USGS Professional Paper 580, 270-277, 1968.
- Harris, L. D., Oil and Gas data from the Lower Ordovician and Cambrian rocks in the Appalachian Basin, USGS Map I-917-D, 1975.
- Jolly, J. L. and A. V. Heyl, Mineral paragenesis and zoning in the Central Kentucky mineral district, Econ. Geol., 59, 596-624, 1964.
- Kyle, J. R., Brecciation, alteration, and mineralization in the central Tennessee zinc district, Econ. Geol., 71, 892-903, 1976.
- Lawrence, R. A., Ore deposits of the southern Appalachians, in J. D. Ridge, ed, Ore Deposits of the United States, 1933-1967, vol. I, American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, 155-168, 1968.
- Mayhew, M. A., and S. C. Galliher, An equivalent layer magnetization model for the United States derived from Magsat data, Geophys. Res. Lett. 9, 311-313, 1982.
- Mayhew, M. A., H. H. Thomas, and P. J. Wasilewski, Satellite and surface geophysical expression of anomalous crustal structure in Kentucky and Tennessee, Earth Plan. Sci. Lett. 58, 395-405, 1982.
- Mayhew, M. A., R. H. Estes, and D. M. Myers, Remanent magnetization and three-dimensional density model of the Kentucky anomaly region, Final Report, NASA Contract NAS5-27488, 90 pp. 1984.

McKnight, E. T., W. L. Newman, and A. V. Heyl, Jr., Zinc in the United States, USGS Map MR-19, 1962.

_____, Lead in the United States, USGS Map MR-15, 1962.

Soderberg, R. K., and G. R. Keller, Geophysical evidence for deep basin in western Kentucky, Amer. Assoc. Petrol. Geologists Bull., 65, 226-234, 1981.

U.S. Geological Survey and American Association of Petroleum Geologists, Tectonic map of the United States, 1962.

Van Alstine, R. E., and J. W. Sweeney, Fluorspar, in Mineral Resources of the Appalachian Region, USGS Professional Paper 580, 286-288, 1968.

Weldon, H., Jr., A. V. Heyl, and J. W. Sweeney, Zinc and lead, in Mineral Resources of the Appalachian Region, USGS Professional Paper 580, 450-453, 1968.

Worl, R. G., R. E. Van Alstine, and A. V. Heyl, Fluorite in the United States, USGS Map MR-60, 1974.

Zietz, I., Composite magnetic anomaly map of the United States, U.S. Geol. Surv. Map GP-954A, 1982.

FIGURE CAPTIONS

Figure 1. Tectonic elements and mineral localities in Kentucky and Tennessee. Heavy line is -30 mgal gravity contour outlining Kentucky body (KYB). Light broken line is one contour line selected from aeromagnetic map of Zietz (1982). Cincinnati Arch delineated by zero level structure contour (dot-dash line) on top of Trenton (USGS and AAPG, 1962). Short dashed lines are generalized faults delineating Rough Creek Graben of Soderberg and Keller (1981) and Rome Trough (Ammerman and Keller, 1979). Symbols 1, 2, 3, a, b refer to Table 1. Modified from Mayhew et al (1984).

Figure 2. Locations of cross sections shown in Figure 3.

Figure 3. Latitudinal and longitudinal cross sections constructed from map of Harris (1975) showing basement surface faults cutting it. Chicken-track symbol in sections 4, 5, C, and D indicates inferred position of top of "Kentucky body" (Mayhew et al, 1984).

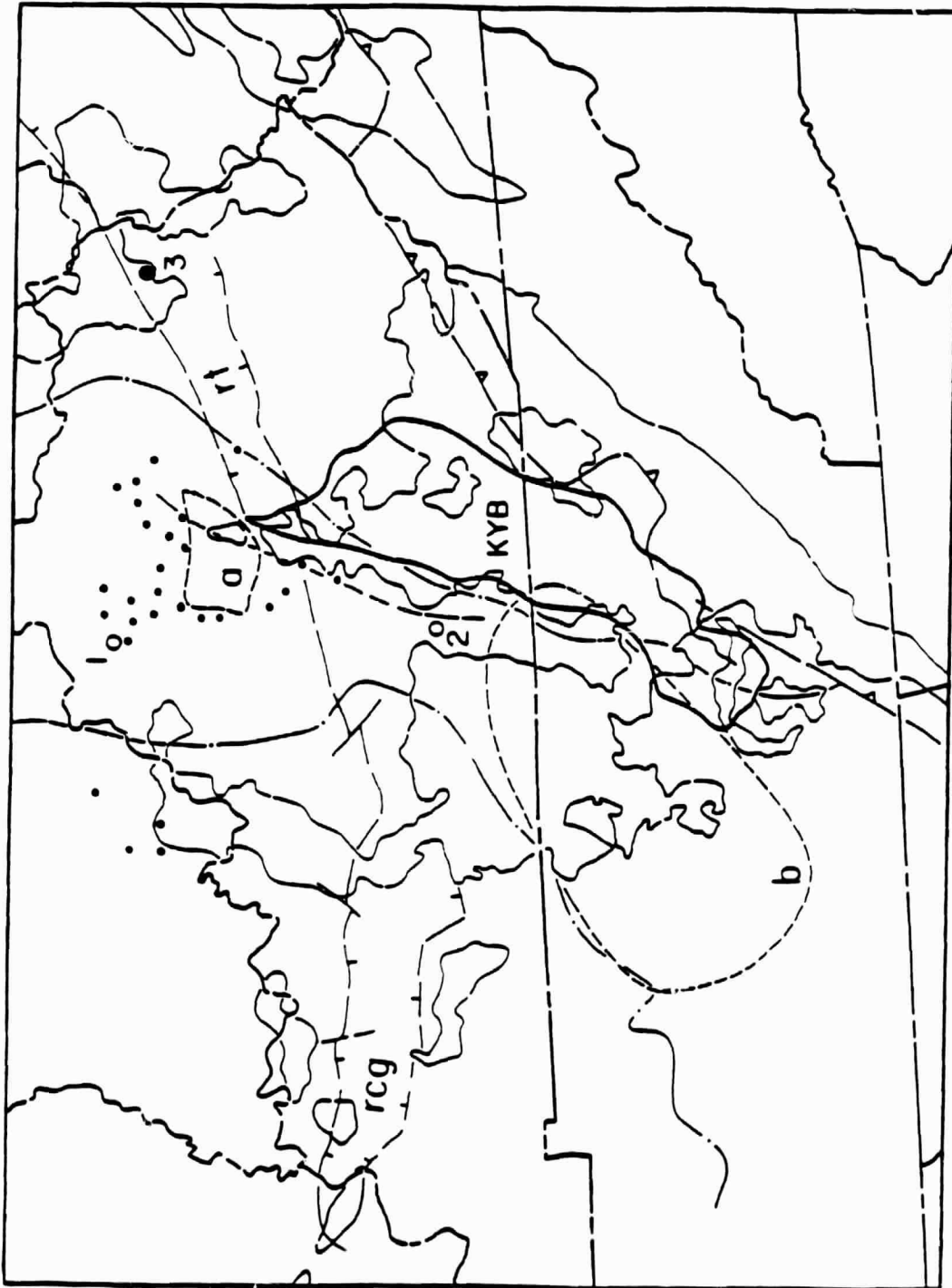


Figure 1

ORIGINAL PAGE IS
OF POOR QUALITY

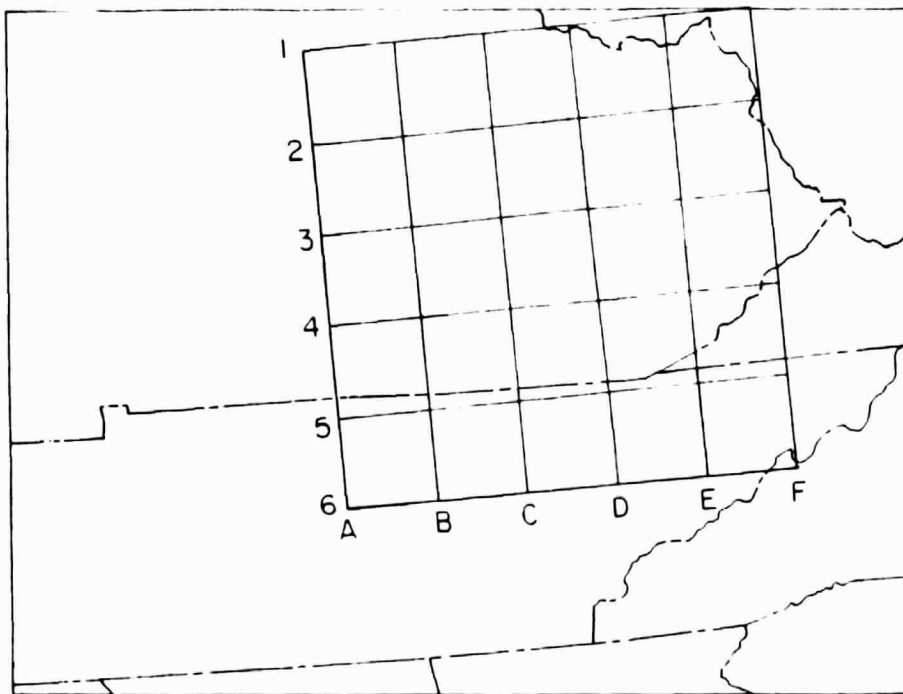


Figure 2

ORIGINAL PAGE 18
OF POOR QUALITY

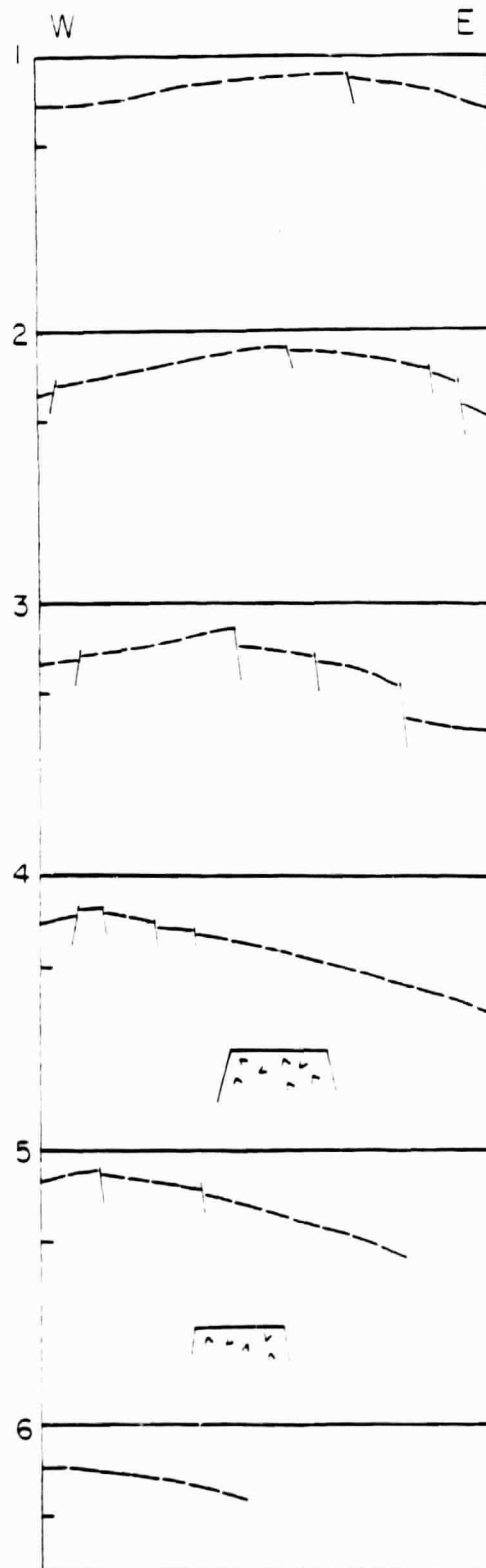


Figure 3a

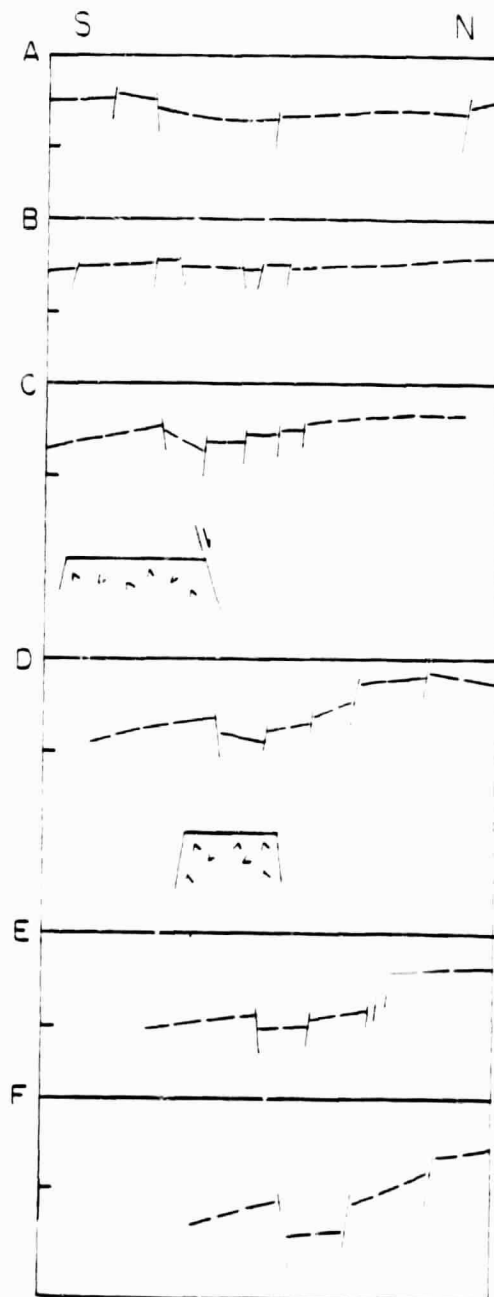


Figure 3b